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AUTHOR Sheu, Feng-Ru
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ABSTRACT

The project described in this paper, representing the initial phases of a one-year on-going project, was organized to build a supportive environment for Instructional Systems Technology (IST) doctoral students at Indiana University-Bloomington to help them prepare for the Qualifying exams. An overview is provided of steps taken to create an electronic performance support system (EPSS) prototype for the IST doctoral students. The aim was to improve productivity by honing the skills and tools they need and providing a supportive environment where students can collaborate and seek advice from each other during preparation. During the process, the concepts of information, collaboration technology, learning and work style, tools and management became important in building the support system. The perspective of socio-technical design, knowledge management, and human approach were applied throughout the process. This paper covers the process of designing the system, including designing principles and rapid prototyping, EPSS prototype and knowledge management, and lessons learned. (Contains 12 references and 5 figures.) (AEF)

A DESIGN OF ELECTRONIC PERFORMANCE SUPPORT SYSTEMS

Feng-Ru Sheu
Indiana University

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Abstract

The purpose of this paper is to provide an overview of what steps were taken to create an electronic performance support system (EPSS) prototype for Instructional Systems Technology (IST) doctoral students to help them prepare for the Qualifying exams. Throughout the design and development process of the EPSS, the principles of socio-technical design and knowledge management were used. To allow for a participatory design, we used a qualitative approach to collect data, and this was followed by interactive designing of the prototype. We used rapid prototyping and usability testing so that the prototype would be customer driven and meet the needs of the end users.

1. Introduction

The project described in this paper was organized to build a supportive environment for IST doctoral students at Indiana University-Bloomington to help them prepare for the Qualifying exams. We seek to improve productivity by honing the skills and tools they need and providing a supportive environment where students can collaborate and seek advice from e ach other during preparation. During the process, the concepts of information, collaboration technology, learning and work style, tools and management became important in building the support system. The perspective of socio-technical design, knowledge management, and human approach were applied throughout the process.

This paper covers the process of designing this system. With reference to the screen shots and the reflections to the design challenges, we hope to instigate readers to continue from where we have left off and/or to explore future developments on EPSS design/creation.

2. Design Problem

This section of the paper presents a basic description of the IST doctoral qualifying exam process. It then discusses some basic features of EPSS. Finally it discusses the semester's design challenge[1]: to build an EPSS to support doctoral students preparing for the qualifying exams.

2.1 The Qualifying Exam Process

Qualifying examinations are an important milestone for doctoral students in almost any graduate program. In the IST program, doctoral students must pass a written qualifying exam as well as an oral qualifying exam before they are admitted as official doctoral candidates and allowed to proceed with their dissertations. Many students view preparing for the qualifying exams as a hurdle that they must get over before moving on to more meaningful research/work as a graduate student. It is a process, which traditionally causes a lot of stress for the individuals preparing for the exams.

Recently, in the IST department, the qualifying exam process changed. In the past, the qualifying exam was based on a closed book format. Over two four-hour sessions on consecutive days, the students had to answer a series of short essay questions with the purpose to be able to analyze and synthesize their knowledge of the field of instructional systems technology. The new process, called the "authentic Quals" gives students a period of three weeks to write three documents on given topics. The documents are not

[1] This is a one year on going project. Paper was written primarily based on the first version of EPSS we created.

essays but rather formats (such as grant proposals, journal articles, etc.) which resemble the types of writing that doctoral students will be engaged in as researchers.

2.2 Electronic Performance Support Systems

While there is still some debate regarding the definition and function of electronic performance support systems (EPSS), the term generally refers to some type of electronic integrated system or infrastructure which provides access to information and tools which enable individuals to achieve a high level of performance. Gery (1991) explains that an EPSS is custom designed to provide access to information, learning activities, and expert consultations at the moment of need. Brown (1996) explains the role of an EPSS: "[An EPSS provides] a context within which work is done. Everything needed to do the job--information, software, expect advice and guidance, and learning experience—is integrated and minimal support and intervention by others....." He adds that the concept of the EPSS is a shift away from viewing workers/performers as "people to be trained" to viewing workers as "people who need support on the job." An EPSS concentrates on the performer, the job, and job tasks.

Corporations are benefiting from the implementation and usage of integrated electronic systems (Borwn, 1996; Raybould, 1995). For example, a large corporation may combine its many electronic tools (including databases, word processing, e-mail, calendars etc.) to facilitate easy access. This can increases the worker's efficiency (Gery, 1991; Kavat, 1997; Raybould, 1995). In addition, an EPSS can also increase the efficiency and productivity of a worker by providing just-in-time coaching and tutorials that can reduce the learning curve and improve performance. For example, a manager needs to write a performance appraisal for an employee. An EPSS can provide this manager the employee's profile and work performance, give the manager advise messages of how to review the employee's performance, and provide a short learning module on how to write performance appraisals.

2.3 The Quals EPSS

The design problem we were faced with was to design an EPSS that would support doctoral students in their preparation for taking the qualifying exams. Although EPSS development and use are more commonly found in the world of business, educators have begun to explore EPSS applications as well (Chiero, 1996). More recently, integrated electronic systems (EPSS) have been developed for use by teachers in grades K-12 (Kavat, 1997) as well as for special education teachers in behavior management (Hung, 1998). For example, an EPSS can provide assistance with the task of creating an individualized lesson plan for a student assessed with learning difficulties in a particular subject. An EPSS can help teachers establish, maintain, and facilitate an effective work environment by improving the performance of their daily tasks. Based on the success of this integrated model, this study is important in discovering the need and benefits of developing a similar system to help doctoral students improve the efficiency of their work/study performance.

We believe that using an EPSS design for the performance support of qualifying exam takers is a good match. The main characteristics of doctoral students' work for Quals are to master the skills of developing their own ideas once they have located, organized, evaluated, and synthesized the existing literature. This is similar to the work in many large corporations and educational settings that have benefited from EPSSs in the past. Also the tasks/works that relate to Quals preparation involve vast amounts of knowledge, technology, and high performance expectations. These features are a few of the major reasons that Brown (1996) mentioned in outlining when an organization/institution should choose an EPSS solution.

3. Design Process

3. 1 Needs Analysis

In order to design a product that will enable people to work effeciently, we must define and understand how they work and what they need to do their jobs, as well as the whole environment. We feel that conducting a complete and detailed analysis before we begin designing it is premature. The gradual determination of the finer details of analysis will emerge as the various levels of users interact with a demonstration prototype. At this stage, the focus of the analysis is to list the performed tasks, the process of detailing work flow, and the process and skills. The analysis techniques include interviews, observation, and document analysis.

3.1.1 Participants

We collected data from people who are involved in the quals process, including faculty members, the quals committee, the department chair, and doctoral students. Shown in table 1, the main charactersitics of doctoral students that we considered based on the deparment profile are gender, maritalstatus, work status, transfer students, and quals taken.

Table 1. Characteristics of Participant

Quals Taken		Transfer Student[2]		Work Status			Marriage Status		Gender	
Yes	No	Yes	No	P/T	F/T	None	M	S	M	F
6	7	8	5	12	1	0	6	7	6	7

3.1.2 Multiple-Perspective Anslysis

During the process, detailed tasks, workflow, the process and skills were analyzed from socio-technical and user-centered desgin perspectives. We determined how each task component contributes to the product based on Carr's classification of tasks: accomplishments, ancillary activities, and distractions (1992.) This analysis helped us to derive efficiencies from electronic support. The effeciency is increased by removing distractions, and effectiveness is increased by supporting completion of necessary ancillary tasks and accomplishments.

4. Designing Principles and Rapid Prototyping

Major principles other than user-centered design principles for multi-media, computer system design, goal—to reduce stress, and change behavior pattern.

With the analysis framework and all the behavior patterns we found, 16 categories of needs were emerged. They are:

- Information
- Tools;
- Stress reduction
- Cooperation & collaboration
- Access to resources/information
- Suggestions and tips
- Writing strategies
- Clear expectations
- Language needs
- Physical organization readings
- Individual work
- Reading strategies
- Useful courses
- Time management
- Extenuating circumstances
- Location for study & writing

Then we created and designed "EPSS solutions" which are suggested for each "need" and would emerged in various levels in the system. Again, a socio-technical approach was applied through out the whole process. We discussed each item (task, process, need, and intervention. etc.) back and forth between micro-level and macro-level and among those perspectives and design guidelines we mentioned before. Figure 3 was part of the instrument that we used to facilitate our discussion. It shows a partial log of the discussion. The category of need could be checked for more than one socio-technical area: Work practice, people, environment technology.

[2] Transfer student indicates the students who have been through the "core course" that is required in the first year of the IST master program.

Figure 3: Example of application of socio-technical principles to writing strategies

Category: C2 Writing Strategies			
Work Practice	People	Environment	Technology
X			
EPSS Suggestions			
1. online debates around specific questions (KNOWLEDGE SHARING) 2. connect to R711 area 3. examples and tutorials for each of the writing formats (PERFORMANCE) 4. collaboration with R711 – suggestion to take (KNOWLEDGE SHARING) 5. reference books about how to improve writing. (INFORMATIONAL) 6. contact information for writing labs (INFORMATIONAL)			

By identifying needs and coming out intervention within border pictures and among all possible interaction that we could think of, the major conceptual categories that we would like to support are:

(a) information management
(b) stress management
(c) collaboration management;
(d) productive through embedded guidance, advice, feedback and work metaphors; and
(e) a problem-solving environment that integrates basic tools, information management, collaboration and productivi ty tools in a seamless environment.

The EPSS included conceptual tools such as information managers, collaborative utilities, and guidance (including suggestions, advices, war stories, reflections) and support mechanisms that reflected or embodied "expert behaviors," that we thought are keys that can lead to good performance in the qualifying exams and should be developed for the quals. They were identified from the interviews with those who had successfully passed the qualifying exams[3] and faculty members.

Building around a strong, meaningful metaphor is key in our design. We tried to incorporate a meaningful metaphor into EPSS to allow students envision the process at the early stage and to alleviate the stress that students felt during the preparation of the exams. Hoping this strategy has impact on their behavior, such as start early, clear vision, reduce stress,...etc.. We would like our potential users to actively participate and buy into the EPSS program.

5. EPSS Prototype and Knowledge Management

In this general overview section we explain several strategies that we tried to use the EPSS to address these issues. Some concepts learned from knowledge management literature that has been incorporated into the design will be discussed as well.

5.1 General Design Overview

Two of the main issues that we wanted to address with the Quals EPSS are:

- reducing the stress involved in Quals process
- making the Quals preparation process more meaningful to the professional development of the students

One thing that we wanted the EPSS to do was to be a catalyst for changing the way students perceived the Quals process. We felt that it was important to help students get the bigger picture early on about how the qualifying exams fit into the whole doctoral program and their future professional development. We hope to help students perceive the qualifying exam process as a learning process that is just an extension of the other professional activities they are and will be involved in.

5.1.1 The Bigger Picture

[3] Mistakes made by all takers also played an important role to help us identify key behaviors.

In order to provide a general EPSS tool that would be useful to all students in the IST program, the Quals EPSS was designed as a part of a larger EPSS. This EPSS would allow students to customize their profiles and include components such as the Quals components if they so desired.

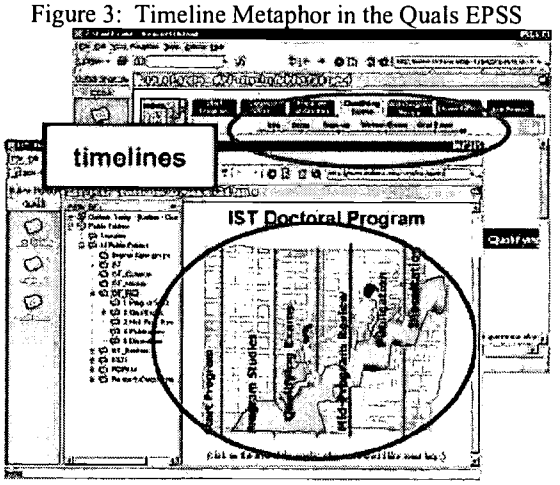
5.1.2 Timeline Metaphor

While the mockup in Figure 3 shows the top level view based on profiles, we also thought that the use of a timeline metaphor for the doctoral student profile would be useful. Figure 3 shows a screen shot of how this metaphor might be integrated into the EPSS.

The use of the timeline metaphor has several benefits that help us to reach the goals of the EPSS. Primarily, it helps to place the Quals EPSS components into the larger framework of getting through the doctoral degree program. In the ideal situation, students would be able to easily navigate back and forth between the different EPSS components. Each "mini" EPSS would help support activities specific to different milestones in the doctoral student timeline.

Part of the impetus for using the timeline metaphor was also to expose incoming students early on in their program to information and tools related to the Quals process. We feel that doing this is a step towards helping students to change their practices of preparing for Quals a semester before.

Figure 3: Timeline Metaphor in the Quals EPSS



Additionally, combining the components under a common metaphor allows for emphasis of skills and other commonalities between major doctoral program milestones.

Finally, within the Quals EPSS components, we continue using the timeline metaphor. Figure 3 shows how the user interface emphasizes the steps that need to be taken in order to complete the qualifying exam process. Prominently featured in the design is the acquisition of skills.

5.1.3 Skills Development Orientation

Another goal of our design was to not only reduce the stress level of studying but to also make the Quals process more meaningful to the doctoral students. The department has taken large strides in this direction by moving to the "authentic" Quals format. We have tried to take it a step further by highlighting within the EPSS three specific skills that will help students to pass the qualifying exams. The skills are:

- Reading Skills
- Writing Skills
- Research Skills

Highlighting these three skills is key to the EPSS because these are the same skills that a student must acquire in order to publish, to get through the dissertation process, and to survive professionally.

5.2 Tacit vs. Explicit Knowledge Features

Tacit knowledge includes ideas that are created in the mind of the individual. It also includes the "mental model" or a framework of how we see and perceive the world. Working mental models can include "schemas, paradigms, beliefs, and viewpoints" (Nonaka, 1994, p.16). Tacit knowledge is deeply rooted in the way we behave and think. As a result, an effort must be made to draw it out of individuals and make it available to others. Conversely, explicit knowledge refers to knowledge that is "transmittable in formal systematic language" (Nonaka, 1994, p.16). Hence explicit knowledge may be more readily available to others. We have tried to apply these principles of knowledge management into our design prototype.

5.2.1 Transferring Tacit Knowledge

As knowledge is not static, but rather dynamic, Nonaka refers to several kinds of knowledge conversion: Tacit to tacit, Tacit to Explicit, Explicit to Explicit and Explict to Tacit. Tacit to tacit knowledge creation (labeled socialization by Nonaka) creates types of knowledge such as embedded and encultured knowledge (Blackler) that tend to be found at more of an organizational level. These types of knowledge depend heavily on shared understandings to be created. They can also reside in systemic routines and cultures found within organizations (see Figure 6). We tried to incorporate encultured knowledge by providing scenarios where the user can read about or listen to the process of how one student explains to another what steps they took to prepare for the Quals and what things they would have done differently. It is explained in terms of the IST culture and how work gets done in IST. The process of socialization is one that may be the most difficult to facilitate with an EPSS; we felt that the a system in which people with a shared goal of passing the qualifying exams can meet is one of the first steps to creating a community. We provided students a social space where students can learn in a collaborative effort. In each section of Reading, Writing and Research skills, students can discuss how they would like to share their exemplar pieces, or seek input from each other of how they would answer a question. In addition, there is a space for them to discuss personal issues such as coping with stress. It may be that just having the system in place will provide people with the opportunities to contact each other and begin the process of sharing and creating tacit knowledge. Tacit to explicit knowledge creation (labeled externalization by Nonaka) will most likely generate encoded knowledge (Blackler). Encoded knowledge is information that is conveyed through signs and symbols. This happens when individuals try to codify or physically represent some piece of knowledge. We found that the knowledge of how to successfully pass the qualifying exams were in the minds of the few. This was done by capturing war stories and documenting students who have taken the Quals and share what they thought were good and bad practices.

5.2.2 Making Knowledge Explicit

Explicit to explicit knowledge creation (labeled combination by Nonaka) represents an area where information processing can create new knowledge. New encoded knowledge can be created through this process as well as embrained knowledge. New embrained knowledge could be created as knowledge "that" and knowledge "about" expands due to transformations of explicit knowledge. Through the process of combination we tried to take explicit knowledge that already exists about the Quals and process it into a form that is more conducive to individual knowledge acquisition. This was primarily done by having all the information about the Quals, the reading list and being able to practice skills for the Quals, all in one place. This also allows for group interactions in a discussion forum where ideas are discussed, transformed, and enriched.

Explicit to tacit knowledge creation (labeled internalization by Nonaka) represents what we most often consider to be traditional learning. This is where knowledge in explicit form (often times abstract knowledge) is made tacit by putting the abstract knowledge to use in a real-world situation or, in other words, learning through grounding the abstract in concrete situations. This move from explicit to tacit often times creates embodied knowledge or knowledge about "how" things are done or familiarity or acquaintance with a system. The process of converting explicit to tacit knowledge can also create new levels of embrained knowledge. The process of internalization was included into the design of the EPSS by providing ways for the students to convert their explicit knowledge into tacit knowledge. For example, there were tools to help students take a technical understanding of the writing formats and convert it into tacit knowledge through practice and comparison with exemplars.

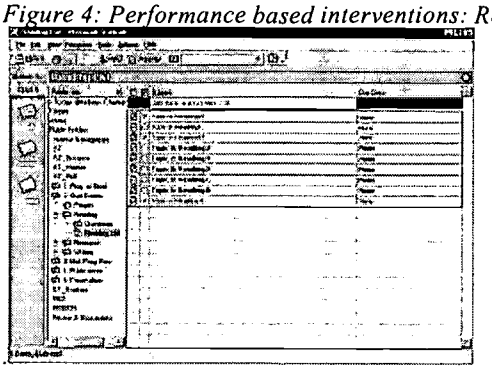
5.3 Quals EPSS as a Productivity Tool

One of the findings from our needs analysis was that doctoral students in general are juggling many different responsibilities and are very interested in improving the efficiency of their efforts especially when it comes to the qualifying exam preparation process. For this reason we believe that the functionality of our Quals EPSS is more heavily weighted towards the productivity end of the spectrum than towards the innovation end of the spectrum. Many of the features of the EPSS (such as sharing advice, war stories, etc.) are geared towards capturing innovative ideas from past Quals takers and making them available in an explicit way to current Quals takers. The idea is that we want the EPSS to improve the productivity of current Quals takers by making their studying efforts more efficient. Making appropriate information readily accessible to the Quals takers is also a way that the EPSS enhances the productivity of its users. A few types of information that are made accessible to the users are:

- Official Information
  - Policy statement
  - Writing formats
  - Ethical issues/ code of conduct
  - Grading rubrics
  - Reading List
- Library/Research Resources
  - Accessing databases (knowing which databases to go to)
  - Keyword / descriptors, related to IST – by topics
  - Using bibliographic info
  - Links to on-line full text / e-journals
  - Links and list of Core journals in the field
  - Basic search skills / strategies
- Bibliographic Info
  - Basics on ProCite and EndNotes
  - Writing format style guides (such as APA)

In addition to providing needed information to students, the EPSS design tried to also focus on creating performance interventions that would help to improve an individual's productivity. An example of one such intervention is providing each student with a checklist of the readings on the quals reading list. The student can then add readings to the list, set a reading schedule, and keep track of what he/she has read. Figure 4 shows a mock up of how an intervention such as this might look in the EPSS.

Figure 4: Performance based interventions: Reading List Checklist



5.4 Knowledge Management Objectives

Davenport (1998) detailed the four following knowledge management objectives:

- Creating Knowledge Repositories
- Improving Knowledge Access
- Enhancing the Knowledge Environment
- Managing Knowledge as an Asset

This section explains how specific features of our Quals EPSS help to accomplish these different objectives.

5.4.1 Creating Knowledge Repositories

There are three main features in our design related to creating knowledge repositories: (1) providing static information, (2) providing dynamic (updateable information), and (3) creating meaningful categories for locating appropriate information.

5.4.1.1 Providing Static Information

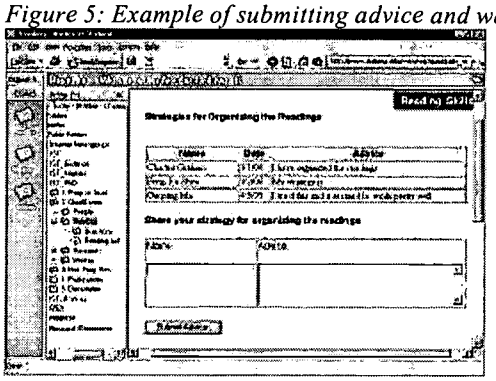
There are lots of specific pieces of static information that are provided through the Quals EPSS. Section 4.3 of this report lists some of them in detail. Static information was typically provided as links to resources or official information. Figure 8 shows an example of a screen shot of a part of the EPSS where static information regarding official Quals information is provided.

5.4.1.2 Providing Dynamic (updateable) Information

There were many ways in which we tried to provide dynamic information to the EPSS user. One of these ways was to provide a space for individuals to post questions and get responses. For this we used the public folder feature of MS Outlook. The EPSS contains a separate folder for each of the main skill areas of reading, writing, and research. Each of these folders has a "Questions" sub-folder where students can post questions they have and get answers posted by other students or faculty members.

Additionally, the EPSS will have forms that allow students who have already taken the exams to submit advice and war stories to a database for students who will be taking the exams in the future (see Figure 5).

Figure 5: Example of submitting advice and war stories



Another dynamic feature of the EPSS will allow students to share information about bibliographic databases as well as the database files themselves. So a student who wishes to use EndNotes may get advice and give advice to others about how to use the tool. The EPSS will also allow individuals to share their EndNotes or ProCite database files with other students. So a student just starting the program could begin with an EndNotes database file that already has the qualifying exam readings in it.

5.4.1.3 Meaningful Categories for locating information

A final area that is related to the EPSS providing knowledge repositories to the students is through its organization of the information into meaningful categories. A knowledge repository is not very useful if you cannot quickly find the information you want within it. In the EPSS we tried to simplify the interface by creating a timeline of tasks related to the Quals and also focusing on skills acquisition (See Figure 11). We felt that most of the critical information fit nicely into these categories. In addition to providing a few

categories, a search capability is also planned for the EPSS, so that the entire EPSS database can be searched for key words.

5.4.2 Improving Knowledge Access

Finding ways to provide improved access to available knowledge was another focus of our design. The primary way we did this i was to provide a mechanism for the sharing of contact information among individuals who are taking the qualifying exams. Figure 12 shows an example of the contact list, which is updateable. Only students wishing to have their names included on the contact list would be listed there. In addition to regular contact information, the contact list gives information regarding when each individual plans to take the qualifying exams.

A few other ways in which access to information rather than the information itself is provided through the EPSS is via access to the Quals preparation listserv, providing contact information for the writing labs, and through access to information and writing feedback available to the R711 students.

Finally, access is provided to library resources. However, we didn't want to just provide links to the main library resource page. So, under the "Research" area of the EPSS we provide access to the specific online journals that are related to our field. We also provide information regarding listings and call numbers for non-electronic journals related to IST as well as search terms related to the field and especially related to the reading categories.

5.4.3 Enhancing the Knowledge Environment

We attempt to enhance the knowledge environment by making it comfortable and useful for everyone that wishes to use it. We tried to do this by using the timeline metaphor that pervades the design prototype. We use this metaphor to try and subtly facilitate a behavior change. We hope that the timeline can serve as a friendly reminder to students of how their preparation fits into the larger picture.

We also attempt to enhance the KM environment by including a scenario in the EPSS. The purpose of the scenario is to get students thinking early on about the issues related to quals and to get them motivated to start preparing for the quals early. In a way we are using the scenario to try and increase "cultural receptivity" to the quals preparation process.

We also believe that the knowledge environment is enhanced through the integration of important skills such as reading, writing, and research throughout the entire Quals EPSS as well as the other EPSS components under the doctoral student profile in the IST EPSS. The knowledge environment is enhanced because familiar themes in the form of skills will surface no matter where the user is in the system.

5.4.4 Managing Knowledge as an Asset

Figuring out how to manage knowledge as an asset was one of the most difficult challenges of the EPSS. There are two main ways that we see the EPSS playing a role in managing knowledge as an asset.

- through acquisition of valuable skills
- through sharing of bibliographic database files – combining assets of individuals to make a larger whole.

Skills such as reading, writing, and research are certainly invaluable assets to any doctoral student. One's ability to adeptly perform tasks related to these three areas is certainly a form of "intellectual capital" belonging to the student. The EPSS helps students to acquire and enhance these skills.

Secondly, knowledge can be captured in bibliographic database files (with ProCite or EndNotes). This might include the bibliographic information as well as short summaries, key words, etc. Once this knowledge has been captured, the EPSS provides an easy way for students to manage and share this explicit knowledge as an asset.

6. Reflections

As we reflect back on the process that we have gone through in rapid prototyping an EPSS to support doctoral students preparing to take the qualifying exams, we feel that we have learned a lot about EPSS design. In particular, both user-centered and socio-technical perspectives and knowledge management have impacted our design.

6.1 Underlying Psychology

As we began to work on the EPSS using a socio-technical design framework, we really focused on the "work practices", the process of work practice, and the interaction with environment, people and technology. We then tried to understand the underlying psychology behind why students do what they do in preparing for the qualifying exams. This focus helped us to identify the components of (1) stress and (2) desire for efficiency that seem to pervade most student's approach to preparing for the qualifying exams. Once we understood this, we were able to develop the timeline metaphor for the EPSS. Also, it became one of the frame factors that helped us to focus many of the interventions within the EPSS towards skills development in the areas of reading, writing, and research.

6.2. Knowledge as Process vs. Knowledge as Object

Another idea that impacted us was changing our conception of knowledge from only "knowledge as object" to also include "knowledge as process." At the outset of the project, our group had the idea that an EPSS was primarily a "knowledge bank" or "knowledge repository" where knowledge objects were stored and retrieved at appropriate times. Fairly soon into the semester, we began to change our ideas as we were exposed to the concept of "knowledge as process." This drastically changed how we viewed the EPSS. Instead of just looking for types of information that we could provide to individuals, we began to look at how our EPSS could actually act as a catalyst to change the way people prepared for the qualifying exams. This led us to try and develop and incorporate more performance-based interventions into our EPSS design.

7. Conclusion

We applied a socio-technical design framework, user-centered perspective, and a rapid prototyping approach to the EPSS design. The design was developed by looking at the work practices and psychological behaviors of individuals currently preparing to take the qualifying exams as well as individuals who have already taken the qualifying exams. The EPSS is built upon the idea that knowledge can be treated both as "object" or "process" and thus incorporates both informational interventions as well as more performance-oriented interventions.

Two of the main (interrelated) goals of the EPSS design have been to (1) reduce the stress of those preparing for the qualifying exams and (2) to increase the efficiency with which the students can prepare for the exams. These goals are achieved, at least in part, by providing an environment which encourages students to begin preparing earlier than a semester before the quals by working to develop skills in the area of reading, writing, and research that will be useful throughout the program as well as in their professional activities. They are achieved by providing the environment that allows students to develop problem-solving skills in the areas of information management, stress management, collaboration management, and productivity improvement.

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